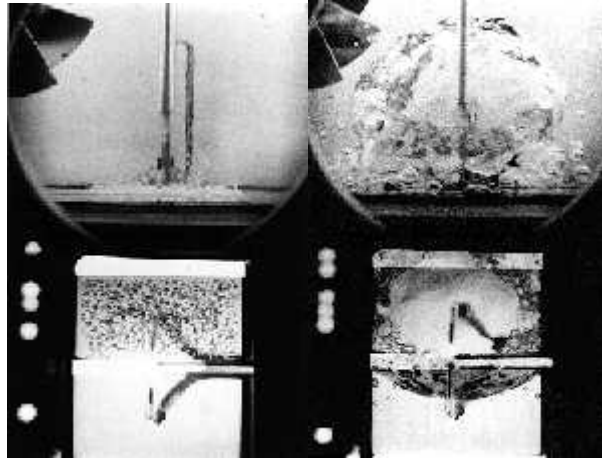


Pool Boiling Experiment Has Successful Flights



Pool Boiling Experiment.

The Pool Boiling Experiment (PBE) is designed to improve understanding of the fundamental mechanisms that constitute nucleate pool boiling. Nucleate pool boiling is a process wherein a stagnant pool of liquid is in contact with a surface that can supply heat to the liquid. If the liquid absorbs enough heat, a vapor bubble can be formed. This process occurs when a pot of water boils. On Earth, gravity tends to remove the vapor bubble from the heating surface because it is dominated by buoyant convection. In the orbiting space shuttle, however, buoyant convection has much less of an effect because the forces of gravity are very small. The Pool Boiling Experiment was initiated to provide insight into this nucleate boiling process, which has many Earthbound applications, such as steam-generation power plants, petroleum, and other chemical plants. Also, by using the test fluid R-113, the Pool Boiling Experiment can provide some basic understanding of the boiling behavior of cryogenic fluids without the large cost of an experiment using an actual cryogen.

The experiment was conceived by Herman Merte of the University of Michigan, was developed by the NASA Lewis Research Center, and is supported by NASA Headquarters' Microgravity Science and Applications Division. The pool boiling prototype system, which was initially flown on STS-47 in September 1992, acquired a considerable amount of scientific data. The expected boiling pattern was observed in all high-heat-flux cases, but a different pattern was observed in the low-heat-flux cases. These differences appear to be caused by the rewetting of the heater surface. The film data indicate that the saturated cases experienced a more activated boiling process (more vapor than expected was generated).

Some minor modifications were made in the timing sequences in the test matrix for the next space shuttle flight, STS-57. This was done to increase the probability of observing the initial dynamic vapor bubble growth while the camera was running at the higher speed

and to observe the influence of a stirrer on the active boiling process. Observations included the stirrer's effect on the dryout area, the mean heat transfer coefficient, and the nucleate boiling heat transfer coefficient. This latter quantity, which was not originally foreseen as an output from the measurements, resulted from observing the relationships between the mean heater surface temperature and the fractional heater surface dryout area over the long microgravity times available on the shuttle.

Currently, results appear to indicate the potential for quasi-steady nucleate pool boiling in long-term microgravity, with certain combinations of levels of heat flux and bulk liquid subcooling. These were the first experiments of nucleate boiling obtained for long periods of microgravity, and the matrix test conditions were selected in part to cover the reasonably broad range of parameters. Hardware is now being modified for two reflights of this apparatus. Higher subcoolings will be explored in the first flight and lower heat flux values will be studied in the second flight. It is expected that "explosive" bubble growth will occur at low heat flux values.